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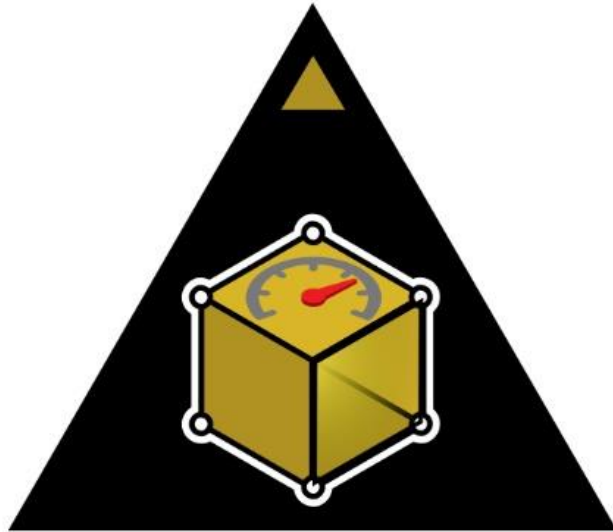


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Capability Development at LANL

Texas Tech University



E-14
TEST
ENGINEERING

Renita Walzel

2/15/2022

This Document has been deemed Unclassified by:
Timothy L Schaefer, R&D Engineer, E-14

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Agenda



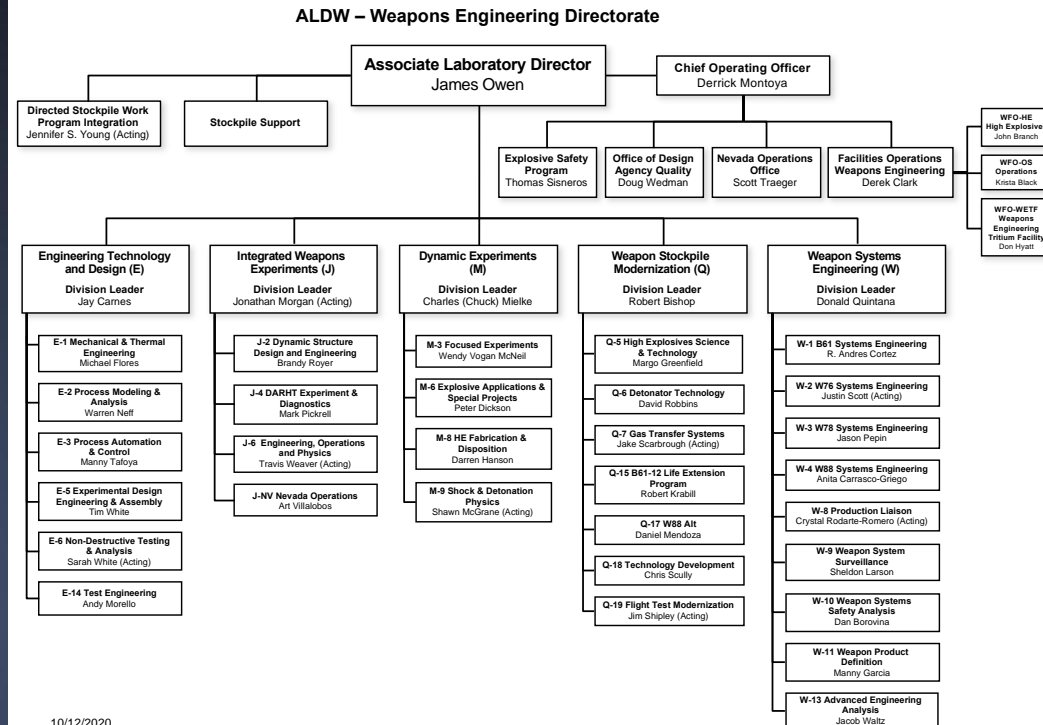
- LANL Organizational chart
- E-14 overview
- DIC testing on Blast Tube
- Questions



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LANL Org Chart

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10/12/2020

E W Q J M WFO



ALDW Consists of 6 Divisions

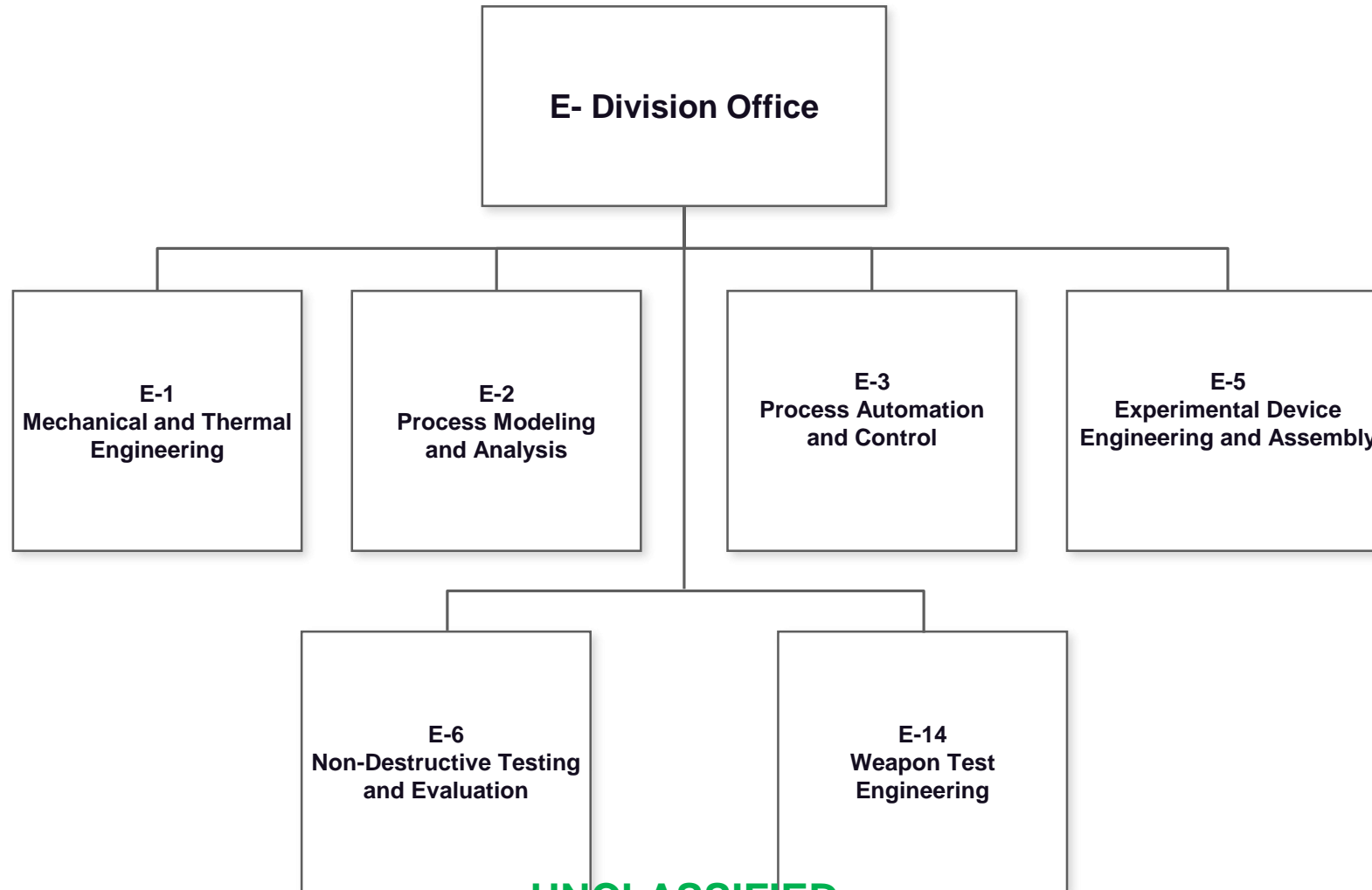
We Are Here

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E Org Chart

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Engineering Technology and Design Division (E)



03/12/2021

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E-14 Overview



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Test Engineering

The Test Engineering (E-14) group has a wide variety of testing personnel and facilities capable of fielding and/or supporting tests on everything from material samples to full weapon assemblies including HE and Rad materials.

E-14 owns and operates a wide variety of experimental equipment including thermal conditioning units, shakers, load frames, data acquisition, air bearing, centrifuge and blast tube to support

E-14 Teams & Expertise



Shock and Vibration

- Small to large Shakers
- Mechanical Shock Machine
- Modal Testing
- Combined Thermal-Mechanical Testing



Mechanical and Thermal

- Small to Large Chambers
- High Ramp Rates
- Material Compatibility
- Long Term Aging
- Multi Segment Chamber Compression
- High Speed and 360° DIC
- Combined Environment Testing



DAQ

- High Speed Reliable Data Acquisition
- Component and Assembly Instrumenting
- Explosive Testing Data
- Calibrated Sensors



Data Analysis

- Environmental Specifications
- Test Data Analysis, Archival and Storage



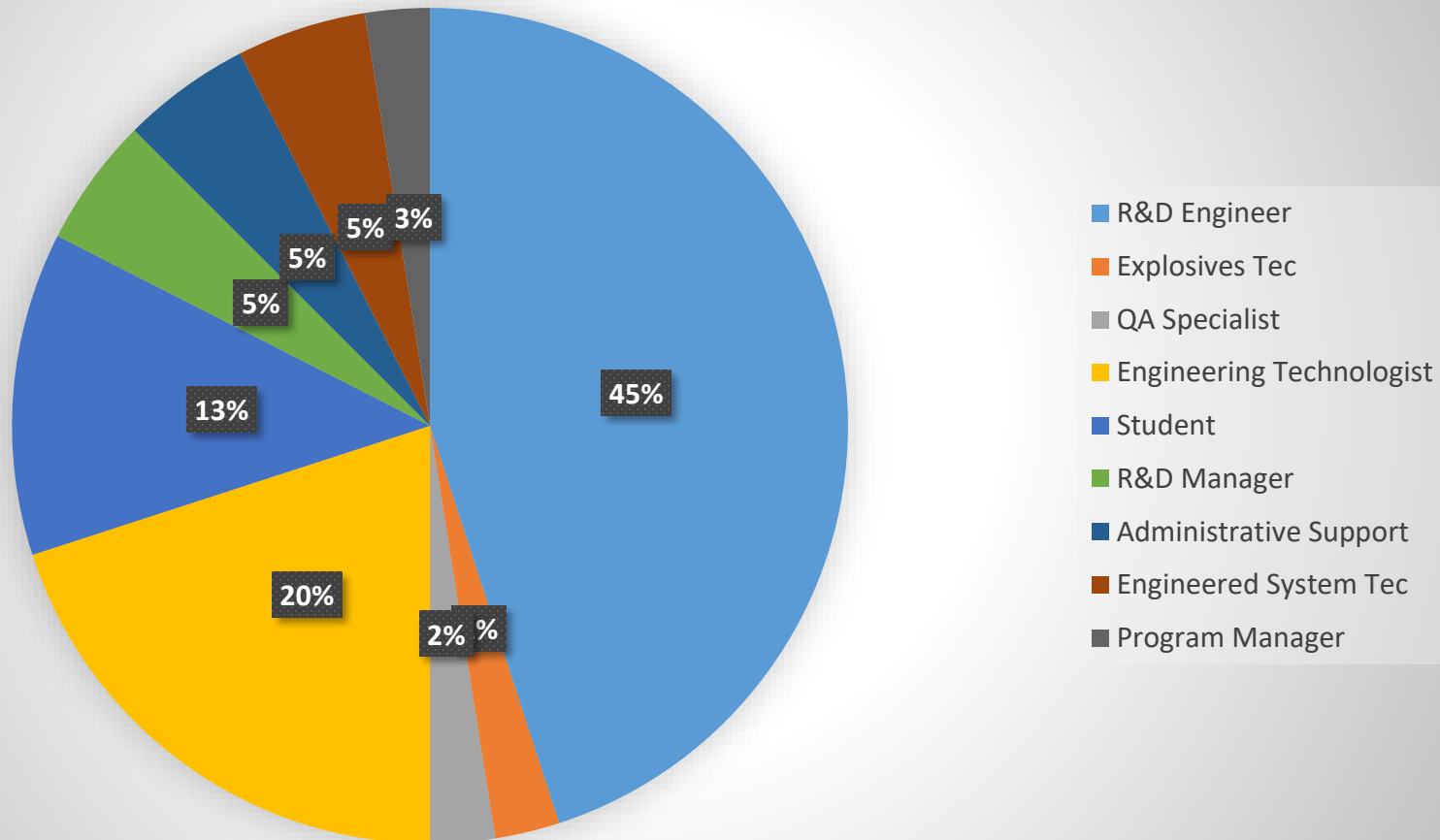
Flight Properties

- Centrifuge
- Products of Inertia
- Horizontal Air Bearing
- Blast Tube
- Separation Shock

- **Experimental evaluation of weapons materials, components and assemblies**
 - Thermal, shock & vibration, and mechanical testing
 - Expertise in non-intentional explosives evaluation
 - Unique data acquisition and diagnostic deployment
 - Management and assessment of complex data and data sets

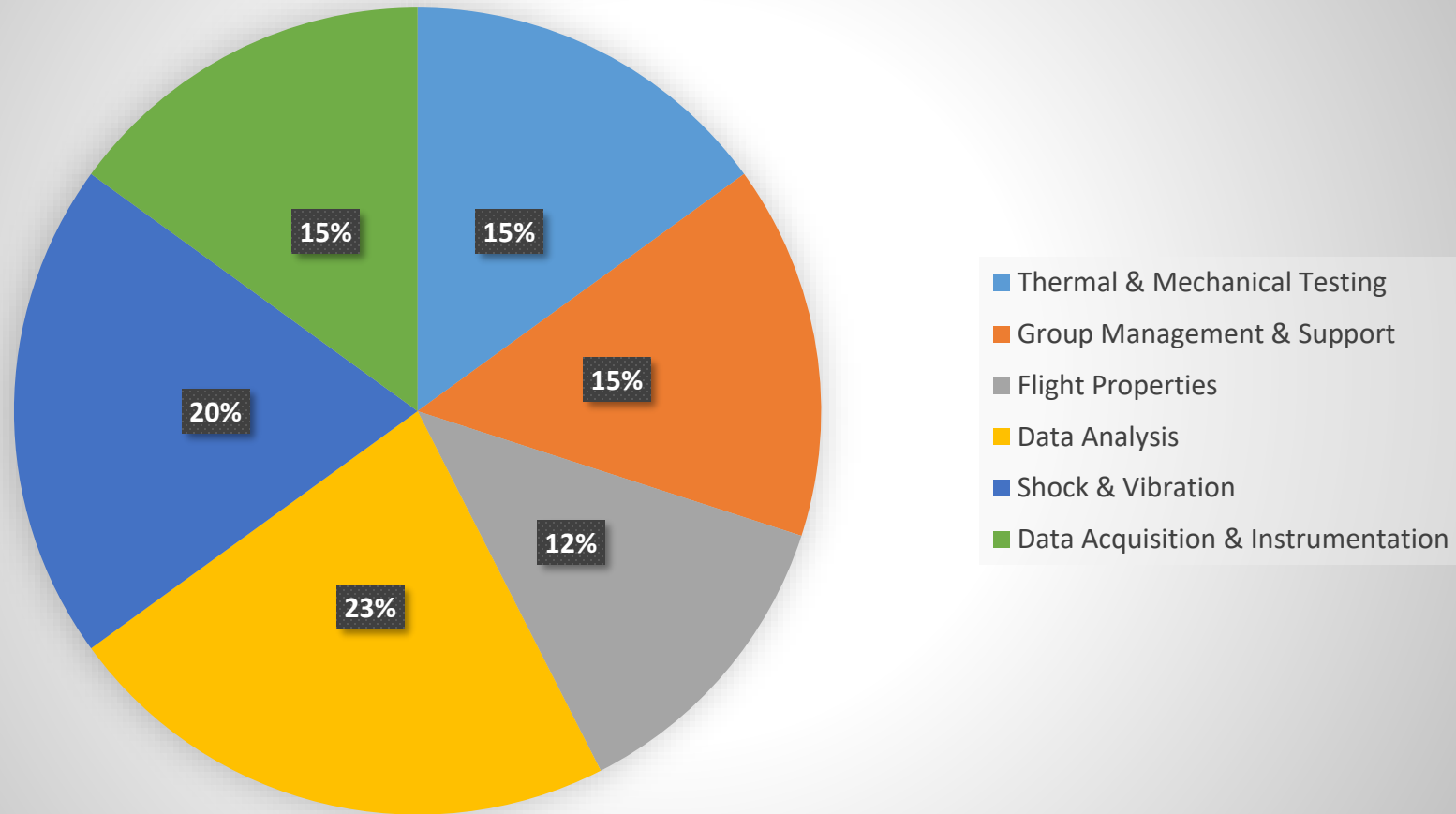
Group Breakdown by Job Function

Personnel by Job Function



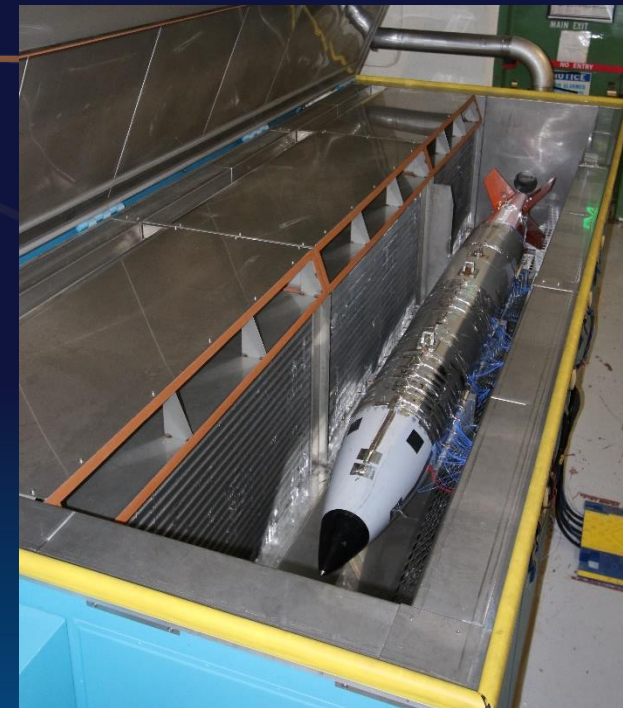
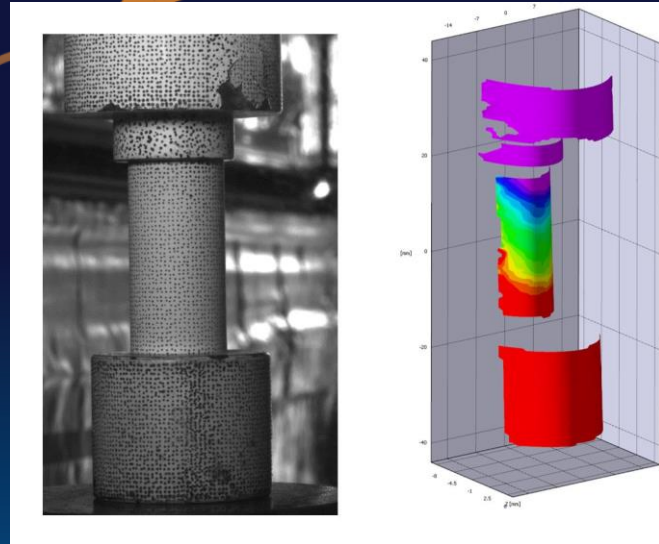
Group Breakdown by Team

Personnel by Functional Team

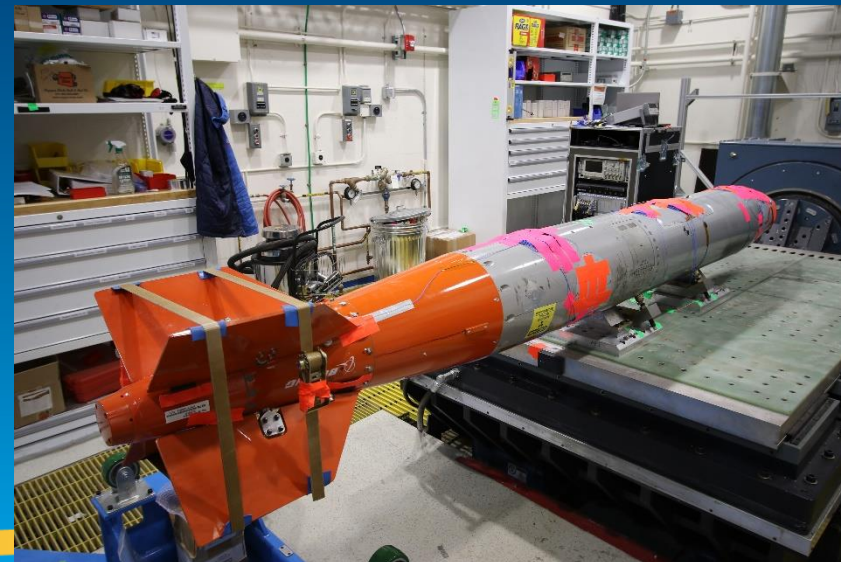


Extraordinary Visuals

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NNSA
National Nuclear Security Administration

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DIC testing on the Blast Tube



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The Blast Tube



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LANL Blast Tube

- Located at Lower Slobbovia with remote bunker operation
- Utilizes existing sled track as foundation
- 8 ft diameter, 2 inch side wall
- 5 – 30 ft long sections for test lengths of 30', 60', 90', 120', 150'
 - 2 HSLA-100 tube sections to sustain source term detonation
- ARMAGs used for DAQ
- Pressure measured along side and at test end
- Capable of testing objects with live HE



Explosive Configuration

Rolling
Backstop

25' Gap



6" Diameter surrounded by C-4



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190lb shot



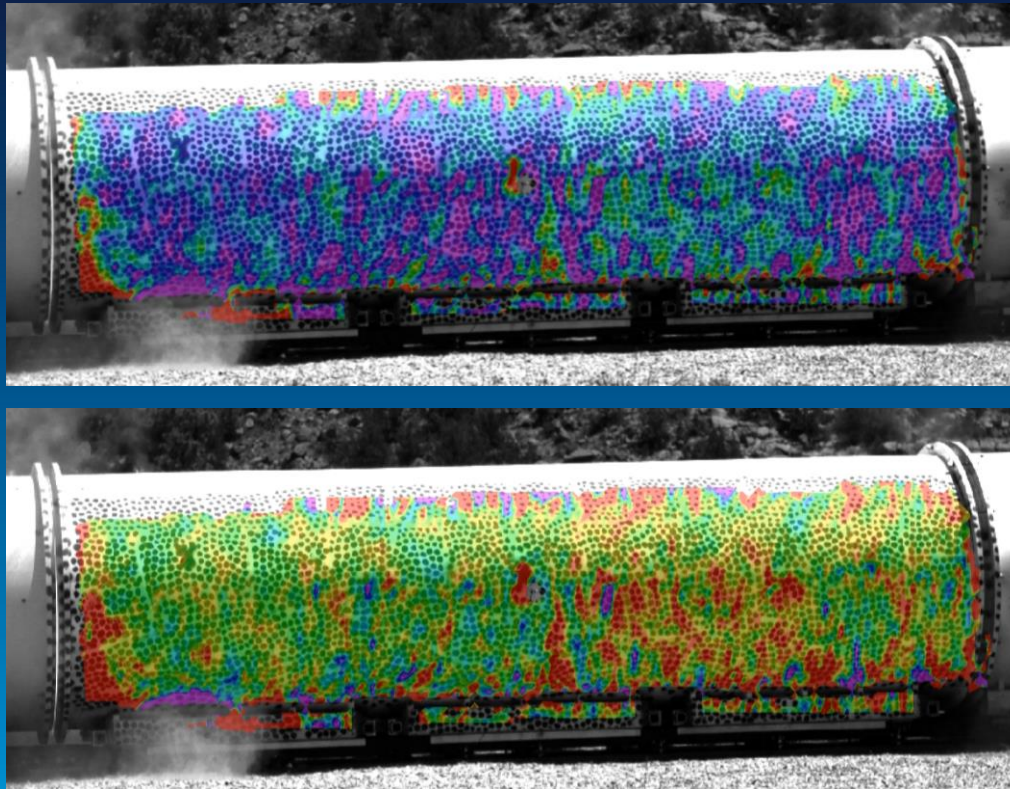
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190lb shot



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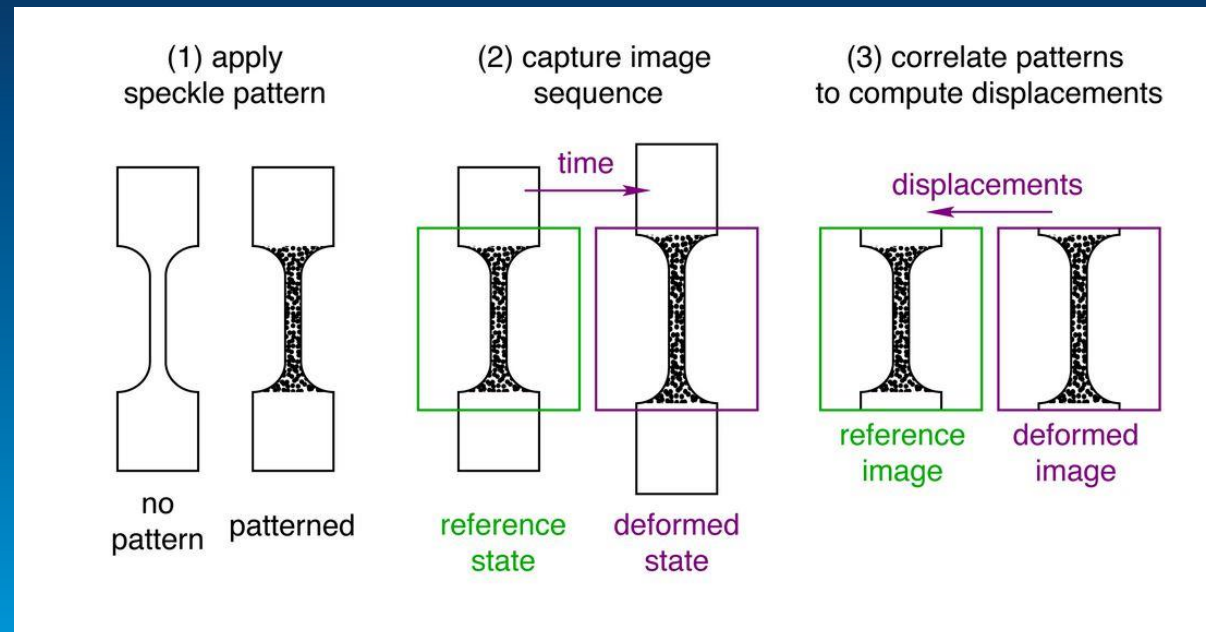
Digital image correlation (DIC) is used to understand tube motion and stress-state during source-term event

Why DIC on the Blast Tube?

- Large area of interest
 - Able to obtain data over a large area vs. points along the blast tube
- Able to obtain data outside of normal range

What is Digital Correlation (DIC)?

- Surface displacement measurement technique used to capture the shape, motion, and/or deformation of a test object by tracking a pattern in a sequence of images

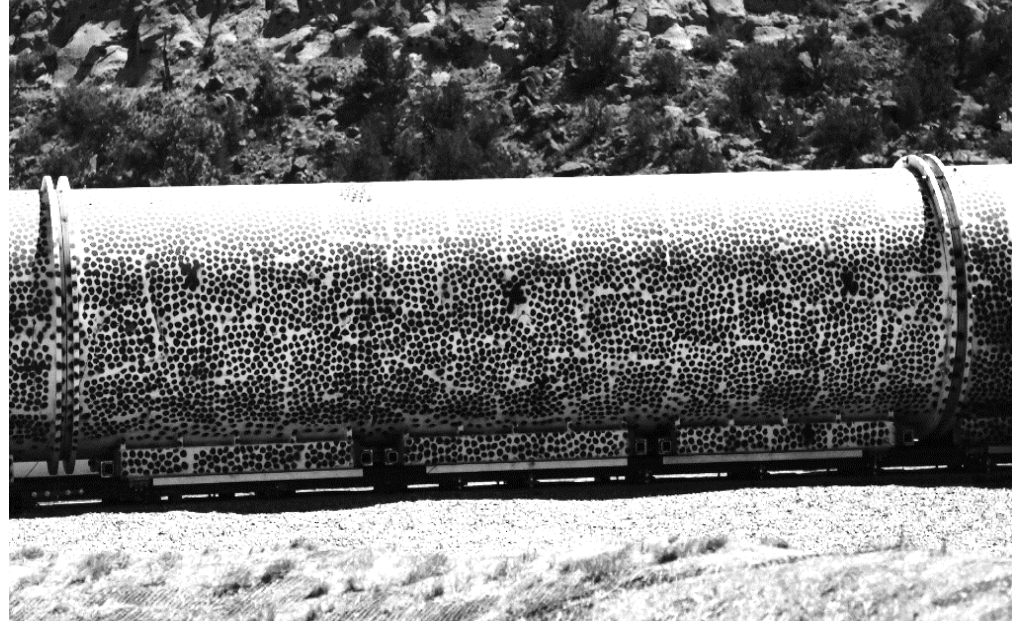


How to Perform DIC on the Blast Tube

- Pre-testing
 - Speckling
 - Calibration
 - Static and Extended Noise Floor
- Testing
- Analysis

Pre-testing: Speckling

- Speckling
 - Size
 - Optimal: 3-5 pixels
 - Variability
 - Random pattern

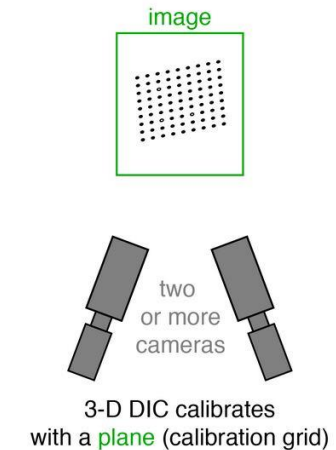
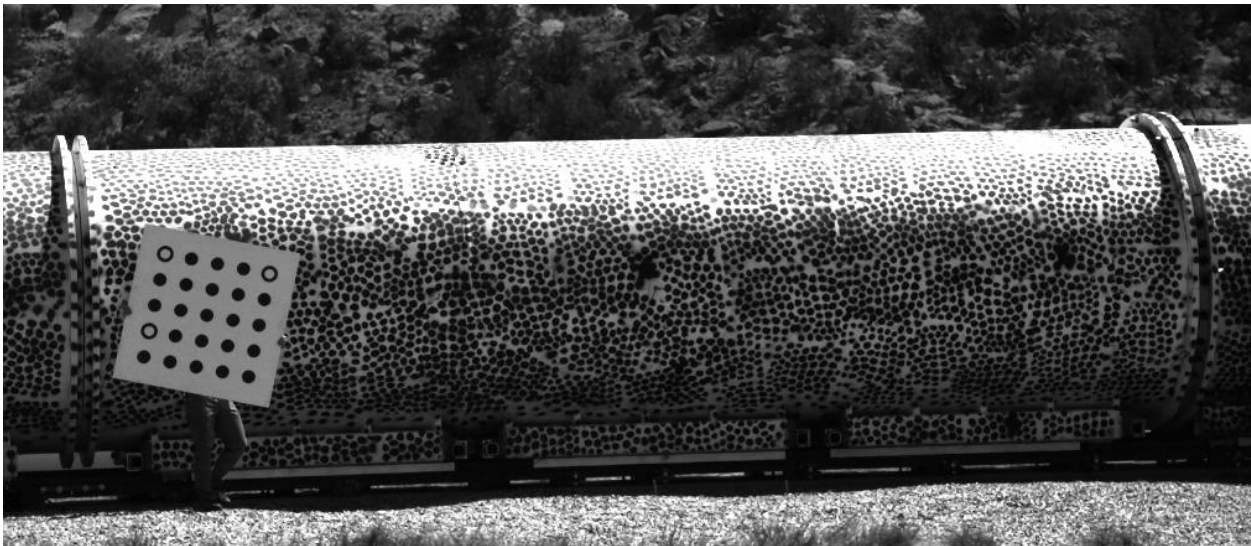


$$\frac{\text{Field of View}}{\text{Chip Size}} \times \text{Speckle Size} = \text{Speckle Pattern Size}$$

$$\frac{30 \text{ feet}}{1024 \text{ pixels}} \times 5 \text{ pixels} = \sim 0.2 \text{ feet (1.875 in)}$$

Pre-testing: Calibration

- Calibration determines:
 - Intrinsic: image scale, focal length, lens distortions, etc.
 - Extrinsic: stereo-angle, distance between cameras, distance from cameras to object



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Pre-testing: Noise Floor Measurements

- Static Noise Floor: analyzes several static images of the test object
 - Heat waves, vibrations, etc.
- Extended Noise Floor: analyzes translation of a similarly speckled object
 - Lens distortion



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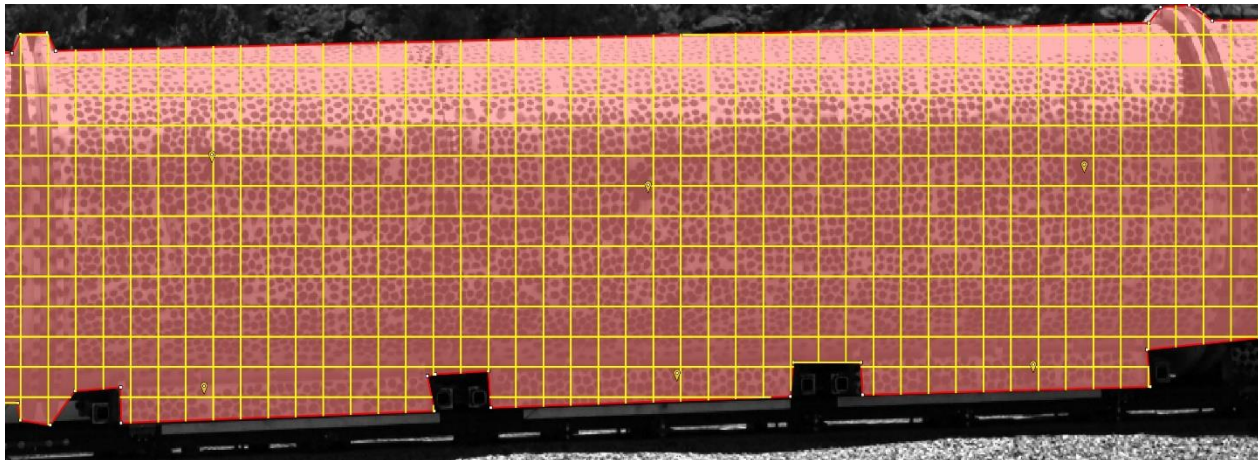
Testing

- Triggering
- Double check
 - Exposure
 - Focus

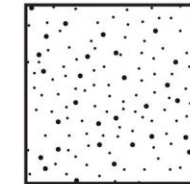
Analysis

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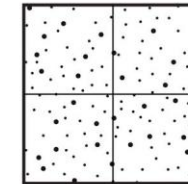
- Subset
 - 4-5 points of interest (speckles)



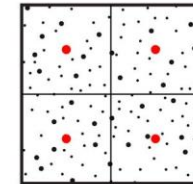
(a) define the reference pattern



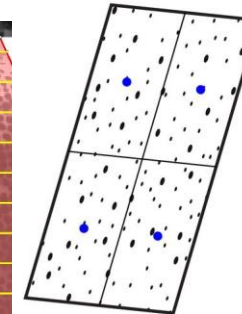
(b) choose subsets



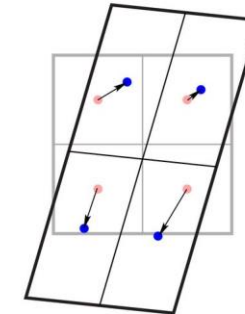
(c) given the subset centers



(d) match the deformed subsets to the reference subsets



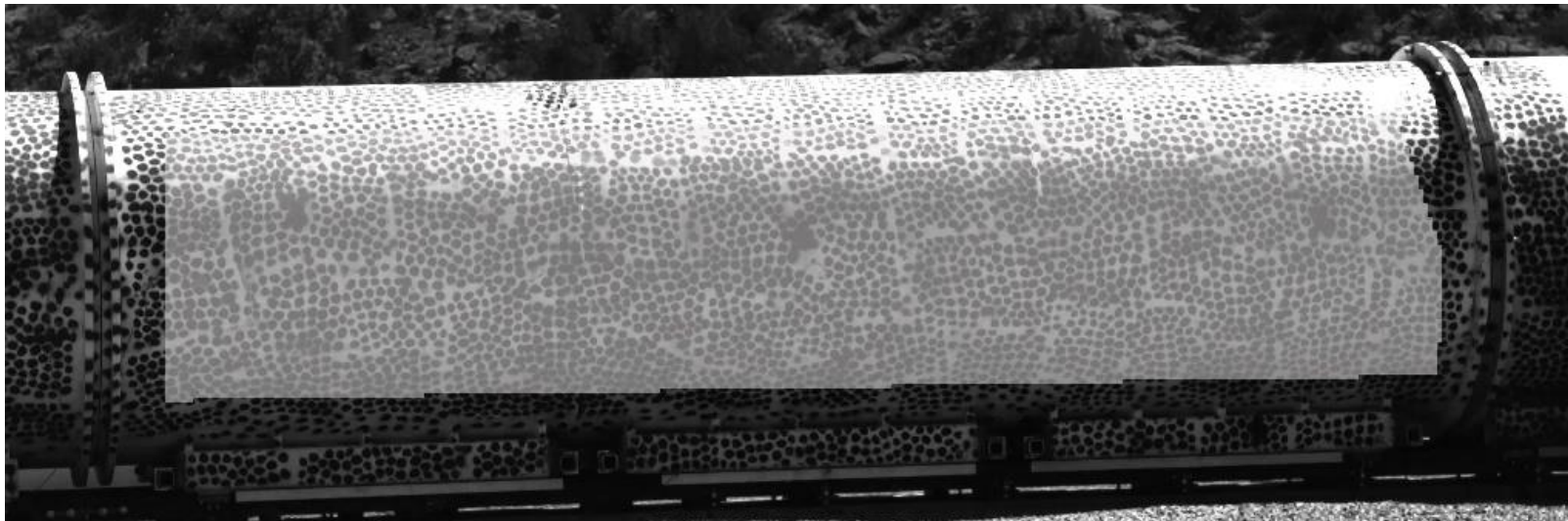
(e) calculate each subset's displacement



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Test Results

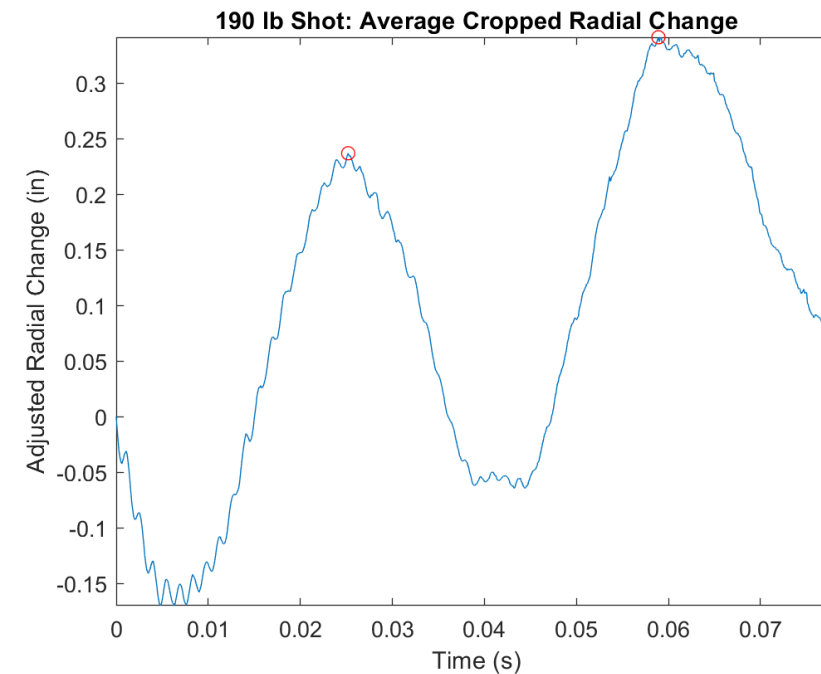
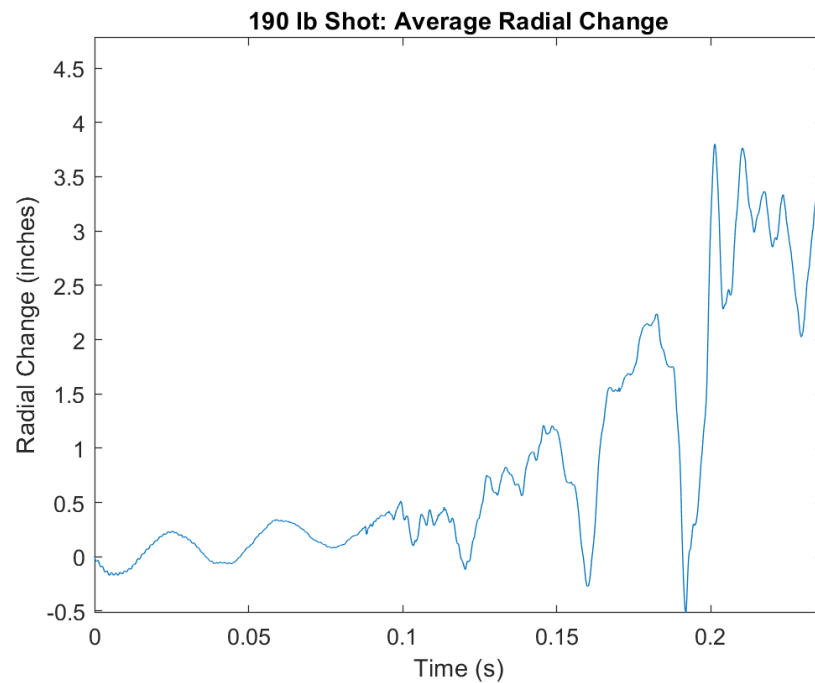
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Initial Results

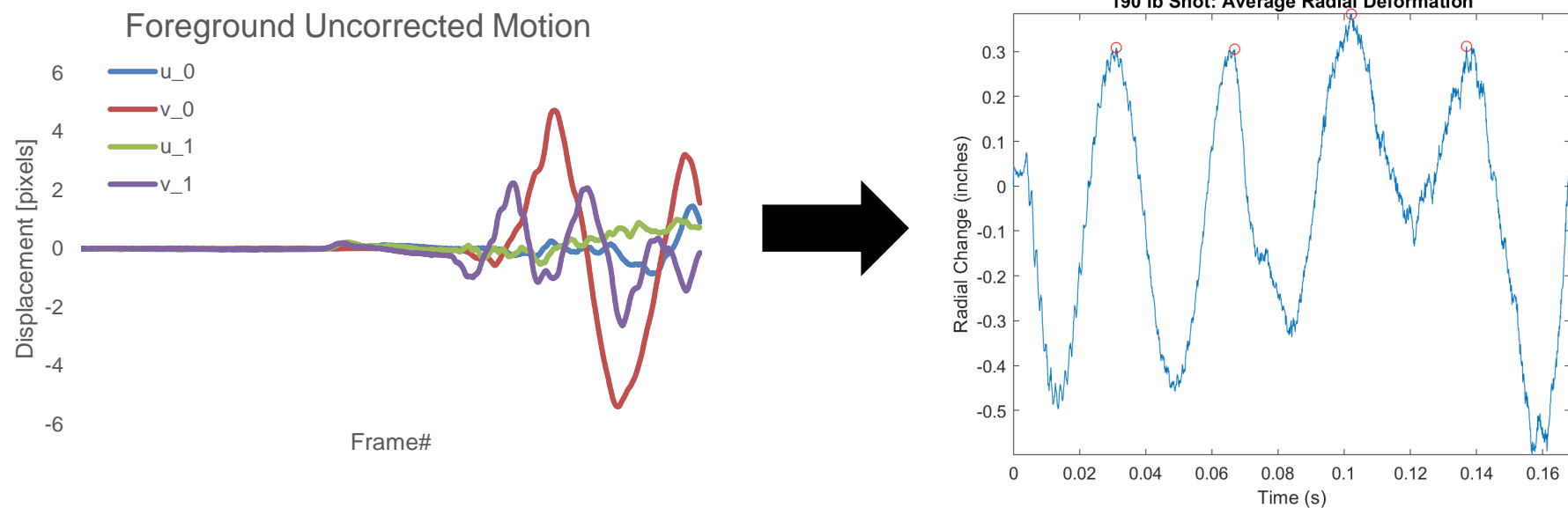
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Updates

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Questions?

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